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POPULATION DYNAMICS AND MANAGEMENT OF DEER IN WISCONSIN

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ABSTRACT

Management of deer in Wisconsin is affected by a combination of biological and environmental factors. In the Northern Forest, winter severity dramatically affects annual survival and recruitment. However, deer density goals here are above "I" carrying capacity. Thus, minor errors in harvest management are in part compensated by herd responses. Deer in the farmland areas of the state are maintained at goals that for the most part are below "I" carrying capacity. Errors in harvest management are magnified in farmland because herd responses are not compensatory. Therefore, the harvest quotas for antlerless deer must be more precise in our farmland than in our Northern Forest. Fortunately, more precise harvest management is possible here because population trends can be more accurately monitored than in forested zones.

The purpose of this paper is to illustrate how deer herd management in Wisconsin relates to what experts have told us about population dynamics, especially how our experience relates to "lessons from the George Reserve" (McCullough 1984). This will be done by contrasting deer herd performance and management in a heavily forested northern zone with deer and management in our farmland deer range.

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REGIONS AND GOALS

Physiography

The state of Wisconsin can be readily divided into a number of physiographic regions based on land use, soils and topography (Fig. 1). The principal zones are the Northern and Central Forests and the Farmland. Other zones such as the Coulee (and Highlands) Region in southwestern Wisconsin could be easily added. However, deer herd dynamics are pretty similar throughout farmland zones of Wisconsin, although productivity tends to increase with decreasing latitude.

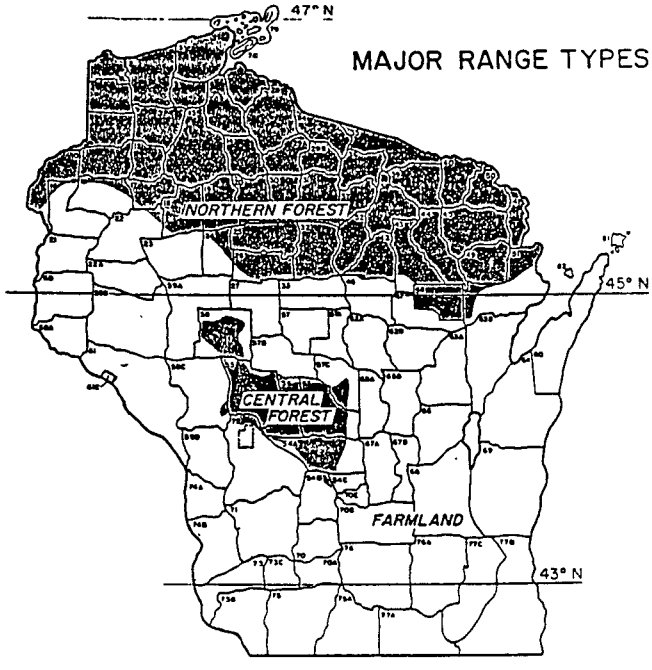

Figure 1. Principal deer ranges of Wisconsin superimposed on a deer management unit map.

There are presently 103 management units and subunits in Wisconsin plus 11 park and island units. Unit boundaries follow highways and rivers that set off areas of generally similar habitat. Units average about 500 mi^2 of gross area and about 300 mi^2 of deer range. They form the basic inventory unit. These relatively small units enable us to apply a reasonably high level of precision in herd management.

The Northern Forest contains 44 units and makes up about 15,000 mi^2 of deer range. It is 80-90% forested

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and experiences a major deer-killing winter about once every 3-4 years. The Central Forest is about 2,300 mi^2, is 70-80% forested, and gets hit by severe winters on an average of once every 6 years.

The farmland range comprises almost half of the deer range in the state, contributing nearly 17,000 mi^2. Major winter losses on the farmland are very rare partly because of their more southerly location and shorter winters, but also because of the availability of highly nutritious forage. Deer often have access to waste grains during winter, and consistently have much better nutrition before and after winter than deer in the forested zones.

Goals

Wisconsin established overwinter deer population goals for all units in the early 1960s (WCD 1962). The original goals have changed little in the Northern Forest and currently range from 10 to 25/mi^2 depending on the demonstrated ability of each unit to produce deer during the most recent decade (Fig. 2). Units with habitats comprised predominantly of pole-sized or larger sugar maple and swamps have relatively low capability to produce deer. Conversely, habitats comprised of aspen, oaks and openings carry 3+ times as many deer (McCaffery 1986). Thus, empirical estimates of carrying capacity based on herd performance provided a basis for setting goals in forested zones.

Figure 2. Overwinter deer density goals for management units.

The approach to goal-setting was different in the farmland units. Here, tradition and human tolerance played a big part. Some areas had not had many deer in modern times, so goals were set quite low near the existing population levels. In other areas, goals were set with human tolerance in mind. Seemingly, disproportionate numbers of crop damage complaints occur whenever densities exceed about 30 deer/mi^2 overwinter. A herd density of 30 overwinter may increase to about 50 by fall. Goals have gradually increased in the farmland and currently average 22 deer/mi^2, but only 3 units statewide have present goals over 30.

BIOLOGY

These gross dissimilarities in range types that I've described above, plus a climatic gradient, cause deer populations to behave differently.

Productivity

Herds in the forested zones tend to increase more slowly than is the case on agricultural range. Gross productivity (fetuses/doe) of yearling and adult does is lower and the incidence of fawn breeding is very low in forested zones. Only 3% of fawns breed in the North, whereas 50% breed in the most southern farm range of Wisconsin (McCaffery and Ashbrenner 1989).

Net recruitment

More important than gross productivity is net recruitment: the actual annual growth rate. Since 1980, the estimated average rate of increase from posthunt (1 Jan) to prehunt (15 Sep) was only 1.21 in the Northern Forest compared to 1.57 in farmland represented by Columbia county (Fig. 3). This big difference is caused by

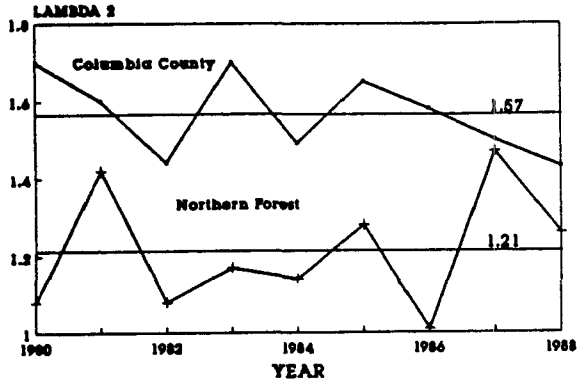

Figure 3. Rates of deer herd increase from posthunt to prehunt for Columbia county (south central Wisconsin farmland) and the Northern Forest.

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a number of factors, only one of which is fertility. Others major factors include winter mortality and subsequent survival of new born fawns. High neonatal mortality (death within 48 hours of birth) is a very significant factor reducing net production following severe winters in the North (Verme 1962).

The impact of winters is especially evident in the Northern Forest where recruitment was depressed following severe winters in 1981-82 and 1985-86 (Fig. 3). The high levels of recruitment in 1981 and 1987 followed a near record and a record mild winter. Irregularities in the estimates of recruitment for Columbia county also suggest winter impacts, but may be exaggerated by errors in population estimates. The apparent downward trend for Columbia county is not believed to be significant.

Mortality

Deer die from a host of causes. In the Northern Forest, nutrition-related causes are the most common and outnumber harvest mortality in many management units. The actual number dying from non-harvest causes is not known and must be estimated. The magnitude of non-harvest loss varies most directly with winter severity, and these losses can be predicted with some degree of accuracy (Creed, et al. 1984:256). But because of variable non-harvest losses and also extremes in annual hunting weather which affects accuracy of population estimates, very precise harvest management in the Northern Forest is not possible.

In farm country, deer die from farm accidents and car-deer crashes at higher rates than in the forested zones, but the total non-harvest loss is believed to be minor compared to hunting removals. Hunting is clearly the greatest cause of deer deaths in farmland and non-harvest losses are easier to estimate because they annually vary less than in the North. Thus, population estimates and projections are more accurate for our farmland herds.

Population trends

In the Northern Forest, the fall herd declined from 430,000 in 1964 to below 200,000 in 1972 following a sequence of severe winters (5 out of 8). It subsequently recovered and has recently ranged mainly between about 300,000 and 350,000 (Fig. 4). It presently is at an all time high, spurred in part by a record mild winter in 1986-87. This relative stability in recent years is not because of precise harvest management, but mainly because the upper level of

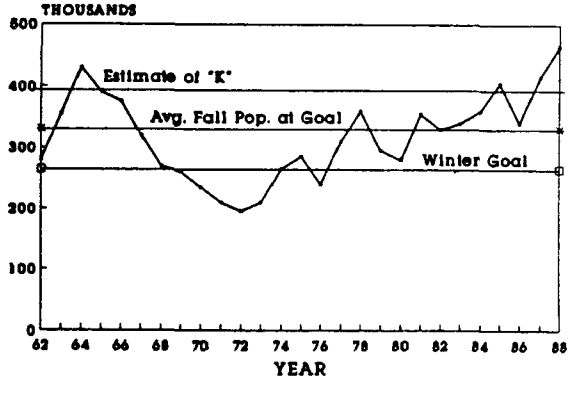

Figure 4. Fall deer population trends in the Northern Forest relative to overwinter population goal, expected fall population, and estimate of maximum average carrying capacity.

herd size has been environmentally constrained. Herds have been in close proximity to carrying capacity. Average maximum carrying capacity here has recently been estimated to be about 26 deer/mi^2 (Lloyd Keith, UW-Madison, in lit. 1987), or about 395,000 deer. Our overwinter goals call for about 265,000 deer and resulting fall populations should average about 320,000.

On the farmland range, herds have increased 6-fold in 25 years and have doubled between 1975 and 1985 (Fig. 5)! We can't depend on natural constraints (winter starvation and poor survival of new fawns) to compensate for deer that aren't harvested because herds are still well below carrying capacity. Carrying capacity in some farmland units may exceed 100 deer/mi^2. An estimate for Columbia county exceeded 80 deer/mi^2 (McCaffery, in lit. 1989).

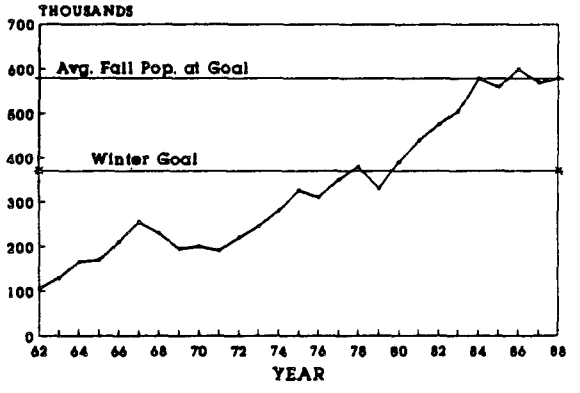

Figure 5. Fall deer population trends for Farmland relative to overwinter population goal and expected fall population. Maximum carrying capacity here may approach or exceed 1,000,000 deer.

CARRYING CAPACITY

One of the problems that DNR has had historically is that we have never produced as many deer in the forested zones as some of our hunters have wanted-- the proverbial "deer behind every tree". The reason for that is biological carrying capacity (the maximum number of animals that can be maintained in a pasture). Many people have related this limitation only to the occasional severe winters. But, winters are merely one of the obvious expressions of climate and the amount of energy required by an animal to survive. Generally, the farther north one goes in the Lakes States, the lower carrying capacity will be for a given type of habitat; growing seasons are shorter, deep snows persist longer, and energy demands on deer are greater. The climate is more harsh. At the northern limit of deer range in Canada, the frequency and duration of severe winters exceeds the energy endurance of deer.

George Reserve

Some scientists have referred to the term carrying capacity as a "slippery shibboleth" (MacNab 1985) because it has been misused and might be best demonstrated in a terrarium apart from extrinsic variables! However, studies on the George Reserve in southern Michigan by Dale McCullough (1979) have provided an illustration of the concept (Fig. 6).

On the George Reserve in southern Michigan, maximum deer carrying capacity, or "K", was calculated to be about 100 deer/mi^2 (McCullough 1979:150). The yield curve (from Downing and Guynn 1983) shows the

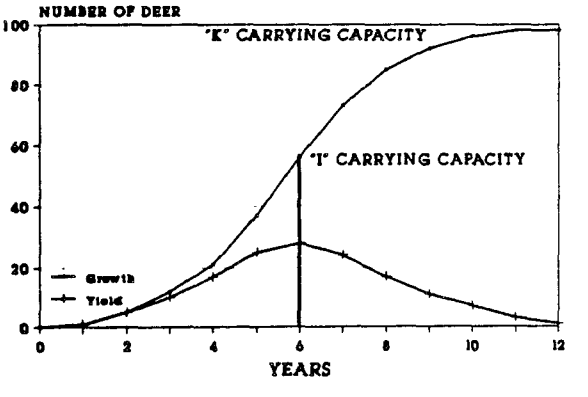

Figure 6. Deer population growth and yield curves showing maximum carrying capacity (K) and point of maximum yield (I). Growth curve is from McCullough (1979:120) and yield curve is from Downing and Guynn (1983).

number of animals produced at any given point on the population growth curve. Midway up the growth curve at 56 animals, the yield would be 28. At any other point on the growth curve the total yield would be less than 28. This point of maximum yield is called "I" carrying capacity (McCullough 1979:150). These curves are representative of the George Reserve. The height of the curve or numbers on the vertical axis would be different for any other area depending on habitat and climate, but the same principles would apply.

Forested zone carrying capacity and goals

In northern Wisconsin, maximum carrying capacity ("K") has been estimated to be 26 deer/mi^2 and our goals have averaged 17.4, which is 67% of "K" (Fig. 7). A goal at this position has advantages. It provides a margin of safety above "I". If the population is driven below goal by overharvest or a severe winter, the

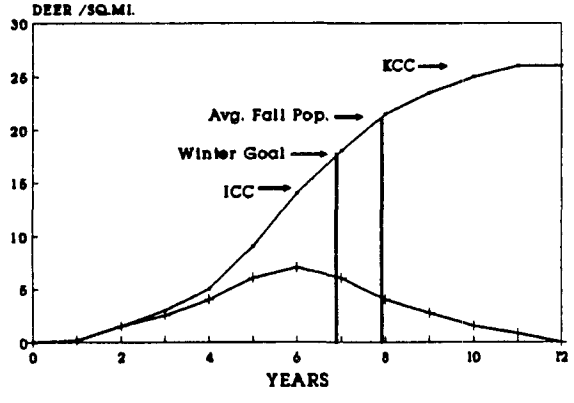

Figure 7. Relative position of over-winter goals and expected fall density to "I" carrying capacity in the Northern Forest.

herd responds by producing a larger increment (so long as it remained above "I"). Conversely, if the herd is underharvested, the increment added will be numerically smaller. Thus, density dependent recruitment will compensate in part for errors in harvest management and the herd will tend to remain near goal.

Agricultural zone carrying capacity and goals

The situation on our farmland range is quite a different picture. Carrying capacity in many units likely exceeds 100 deer/mi^2. Our goals, then, are less than half of "K" and below "I" carrying capacity (Fig. 8).

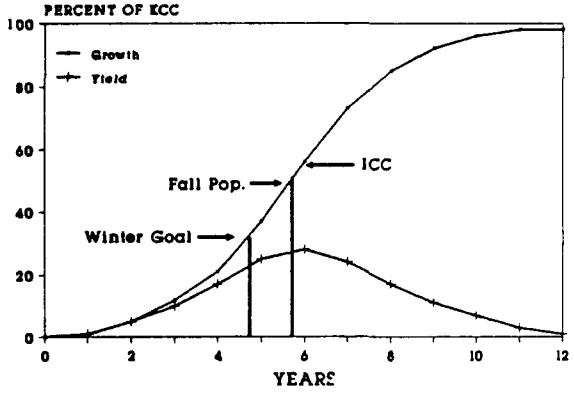

Figure 8. Relative position of over-winter goals and expected fall density to "I" carrying capacity in the Farmland deer range.

If present herds are not adequately harvested, they quickly increase toward higher densities because larger increments are added each year until the wintering herd level reaches or exceeds "I". If the herd is over-harvested, a smaller increment is added the following year and recovery to the desired goal and harvest level will be slower than if the herd were above "I". Thus, the consequences of management errors are magnified when herds are below "I".

MANAGEMENT IMPLICATIONS (STRATEGIES)

Managing deer in the Northern Forest

Regulating herds when goals are above "I" is comparatively easy. Precise harvest management is less critical. If antlerless deer are not accurately harvested, natural mortality and reduced recruitment will normally cause these "surplus" deer to "disappear". Underharvest will be compensated for by increased natural mortality and reduced recruitment. Moderate overharvest will be compensated for by increased deer

production and survival. Thus, a conservative harvest strategy will appear to be as good management as a more aggressive harvest program. However, the latter will provide many more deer for harvest by hunters, and herds and environment can be kept more healthy and productive by doing an adequate job of harvest.

We're still learning. During the 16 years prior to 1976, harvests in the Northern Forest averaged only about 10% of the standing herd. In the most recent 8 years, this harvest rate has increased to almost 14%. Harvests of 15-20% are possible, but aggressive harvest strategies require greater public understanding and support than we have enjoyed historically. Managing northern deer properly in the face of occasional severe winters is a lot like coaching high school football; your support is good when you appear to be winning, but lose and the public can become somewhat hostile irrespective of the causes for losses! Hence, a conservative harvest strategy is often chosen.

Managing deer in agricultural zones

Regulating deer numbers on farmland requires more precise management (harvest of antlerless deer) because population goals are usually below "I" carrying capacity. A conservative harvest strategy is inappropriate. Unlike the Northern Forest, the environment does not exert limits on the herd to compensate for underharvest. Deer will quickly accumulate to intolerable levels. Herds must be regulated at a level consistent with other land uses.

Private landowners must have a major voice in establishing deer population goals in farmland range. Reconciling differing opinions of certain landowners will continue to be a problem that may be primarily the responsibility of the damage abatement program.

The demand to fragment or realign deer management unit boundaries to attempt to resolve local damage situations destroys the unit history which is important to consistent harvest management. A revision in deer population goal is much less disruptive of the management system, and might be given strong consideration before seeking boundary revisions.

What it takes

In the Northern Forest, we can have the biological option of conducting a conservative or more aggressive antlerless harvest program. But, in the farmland range, precise harvest management is necessary. The ingredients for accurate antlerless harvest quotas in farmland include: (1) permanent management units so that a harvest history and database can be maintained, (2) deer population goals consistent with land use needs, (3) accurate harvest registration to monitor deer population trends, and (4) similar length hunting seasons from year to year to facilitate interpreting age and harvest data.

We have this capability for precise harvest management in Wisconsin, but a 5th ingredient is also important. We will continue to need the support and understanding of our many publics.

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